

**WHAT IS CLAIMED IS:**

1. A method for synthesizing a compound having the formula  $E(GeH_3)_3$  wherein E is selected from the group consisting of arsenic (As), antimony (Sb) and phosphorus (P), the method comprising combining  $GeH_3Br$  with  $[(CH_3)_3Si]_3E$  under conditions whereby  $E(GeH_3)_3$  is obtained.
2. The method of claim 1 further comprising purifying the obtained  $E(GeH_3)_3$ .
3. The method of claim 1 wherein the step of purifying the obtained  $E(GeH_3)_3$  comprises trap-to-trap fractionation.
4. The method of claim 1 wherein  $E(GeH_3)_3$  is obtained with a yield from about 70% to about 76%.
5. A method for synthesizing a compound having the formula  $E(GeH_3)_3$  wherein E is selected from the group consisting of arsenic (As), antimony (Sb) and phosphorus (P), the method comprising combining  $GeH_3Br$  with  $[(CH_3)_3Si]_3E$  to obtain  $E(GeH_3)_3$  according to the formula:  
$$3 GeH_3Br + [(CH_3)_3Si]_3E \rightarrow 3 (CH_3)_3Si Br + (GeH_3)_3E$$
6. The method of claim 5 further comprising purifying the obtained  $E(GeH_3)_3$ .
7. The method of claim 5 wherein the step of purifying the obtained  $E(GeH_3)_3$  comprises trap-to-trap fractionation.
8. The method of claim 5 wherein  $E(GeH_3)_3$  is obtained with a yield from about 70% to about 76%.
9. A method for doping a region of a semiconductor material in a chemical vapor deposition reaction chamber, the method comprising introducing into the chamber a gaseous precursor having the formula  $E(GeH_3)_3$ , wherein E is selected from the group consisting of arsenic (As), antimony (Sb) and phosphorus (P).
10. The method of claim 9 wherein the semiconductor material comprises silicon (Si).
11. The method of claim 9 wherein the semiconductor material comprises germanium (Ge).

12. The method of claim 9 wherein the semiconductor material comprises SiGeSn.
13. The method of claim 9 wherein the semiconductor material comprises SnGe.
14. A method for depositing a doped epitaxial Ge-Sn layer on a substrate in a chemical vapor deposition reaction chamber, the method comprising:
  - introducing into the chamber a gaseous precursor comprising SnD<sub>4</sub> mixed in H<sub>2</sub> under conditions whereby the epitaxial Ge-Sn layer is formed on the substrate; and
  - introducing into the chamber a gaseous precursor having the formula E(GeH<sub>3</sub>)<sub>3</sub>, wherein E is selected from the group consisting of arsenic (As), antimony (Sb) and phosphorus (P).
15. The method of claim 14 wherein the gaseous precursor is introduced at a temperature in a range of about 250°C to about 350°C.
16. The method of claim 14 wherein the substrate comprises silicon.
17. The method of claim 14 wherein the silicon comprises Si(100).
18. The method of claim 14 wherein the Ge-Sn layer comprises Sn<sub>x</sub>Ge<sub>1-x</sub> and x is in a range from about .02 to about .20.
19. A method for forming a Group IV semiconductor film, the method comprising forming the Group IV semiconductor by a chemical vapor deposition method, said Group IV semiconductor film being doped with impurities at a concentration ranging from about 10<sup>21</sup> atoms/cm<sup>3</sup> to about several percent, the impurities being selected from the group consisting of arsenic (As), phosphorous (P) and antimony (Sb).
20. A method for forming a Group IV semiconductor film, the method comprising:
  - forming the Group IV semiconductor film by a chemical vapor deposition method; and
  - while forming the Group IV semiconductor film, doping the film with impurities at a concentration ranging from about 10<sup>21</sup> atoms/cm<sup>3</sup> to about 3 at. %, the impurities being selected from the group consisting of arsenic (As), antimony (Sb) and phosphorus (P)

21. The method for forming a Group IV semiconductor film according to claim 20, wherein t arsenic (As), antimony (Sb) and phosphorus (P) are added to the Group IV semiconductor film by diffusion methods.
22. The method for forming a Group IV semiconductor film according to claim 20, wherein said doping step comprises introducing the As, P, or Sb impurities into a reaction chamber as hydride compounds, together with at least SnD<sub>4</sub>, GeH<sub>4</sub>, Ge<sub>2</sub>H<sub>6</sub>.
23. A method of preparing (E)H<sub>x</sub>(GeH<sub>3</sub>)<sub>3-x</sub>, where x= 1 or 2 and E is selected from the group consisting of P, As, Sb, the method comprising reacting inorganic or organometallic compounds of the E element with an alkali germyl or a halogenated germane.
24. The method of preparing (E)H<sub>x</sub>(GeH<sub>3</sub>)<sub>3-x</sub> according to claim 23 wherein the alkali germyl comprises KGeH<sub>3</sub>.
25. The method of preparing (E)H<sub>x</sub>(GeH<sub>3</sub>)<sub>3-x</sub> according to claim 23 wherein the halogenated germane comprises BrGeH<sub>3</sub>.